ENGINEERING NEWS.

Tribune Building, New York City.
GEO. H. FROST, PROPRIETOR.

SATURDAY, MAY 14, 1881.

SURVEYORS and every person interested in the figure of the earth will be pleased with the new work just published, from the pen of one of the most popular writers on mathematical subjects, Professor Mansfield Merriman, of Lehigh University. This book must be read to be appreciated, and we prophesy for it an immediate and rapid sale. Send your orders at once.

THE Austrian engineers have the disadvantage of being too much governed under too many "heads." The ministers of Commerce, Agriculture and of the Interior have all their say as to what engineers shall or shall not do. The Vienna Society has 2,000 members, that of Prague 856, Pesth 938. Belgium has no association of civil engineers proper, but societies of different technologists.

PERSONAL.

C. C. Waite of the Panhandle road, has been appointed assistant to H. J. Jewett, President of the Erie Railroad.

General W. Sooy Smith has accepted the position of Chief Engineer of the Hudson River Tunnel; and General T. E. Sickles that of Consulting Engineer.

Mr. Frank Woods, late Business Manager of the *American Manufacturer* of Pittsburgh, has taken charge of the business management of the *North American Manufacturer* of Philadelphia.

W. D. Clark, formerly City Engineer of Springfield, Ill., has been appointed Superintendent of the Arapahoe County court-house, now being built in Denver, Colorado, at which city Mr. Clark will be hereafter addressed.

Mr. W. W. Jerome, C. E., of Fordham Station, N. Y. City, has accepted a position as engineer for the contractors, Messrs. Simpson & Smith, who are constructing the first fifty miles west of Buffalo of the Buffalo, Pittsburgh & Western Railroad. Mr. Jerome has headquarters at Dunkirk, N. Y.

Mr. H. I. Kimball has been unanimously selected director-general of the Atlanta (Ga.) Cotton Exposition, and has appointed Mr. Charles T. Sabin, of Montpelier, Vt., as Engineer and Chief of the Department of Engineering and Machinery. Contracts for the buildings will be awarded in a few days, the amount of money required, $200,000, having been subscribed. Mr. Kimball is confident that a half million of people will visit the exposition during the three months it will be open.

"The New York State Board of Health has commissioned Prof. J. T. Gardner, of the State survey, its representative, and he will examine into all matters relating to sewerage, drainage and city and town sanitation in England, France, Belgium and Germany. Prof. H. B. Nason, of the Troy Polytechnic Institute, who leaves for Europe in a few days, was also commissioned to examine the methods and results of the safety test for petroleum oils."—*Albany Evening Journal*, 12th.

[This is a pleasant European tour for Professor Gardner, but he will have to traverse the ground just gone over by Mr. Rudolph Hering, of Philadelphia, who undoubtedly has brought back all the information on the subject of sewerage needed by any city in America, and to whom it is decidedly in the interest of cities contemplating sewerage improvements to apply for the latest and most approved methods in use in Europe. Mr. Hering may, without fear of dispute, be accorded first rank among the sanitary engineers of the world.]

On Saturday, the 7th, in Palmer and Sullivan's camp near Acambaro, Mexico, Engineer Sackrider became insane and killed Engineers Martin and Jones. Sackrider was killed by the chief of the party, Filley.

[The above is telegraphed from City of Mexico on the 10th. On page 101, ENGINEERING NEWS, will be found the names of the engineers who were killed, Mr. Filley, and also that of N. P. *Sacket*, but no *Sackrider*. The names are from the list in the office of the National Construction Co. of this city, and are correct. The party went out under the charge of Mr. A. M. Wellington.]

From the Cleveland *Herald* of the 12th we learn that Dr. N. P. Sackrider (not Sacket), a young physician of Cleveland, and son of Mr. Norman Sackrider, Register clerk in the post-office of that city, accompanied the Wellington party of civil engineers to Mexico as medical adviser. He was 37 years old, and was widely known by reason of his holding the position of Health Officer. Up to the evening of the 12th no reply had been received to the telegrams sent to Mexico inquiring about the matter. Engineer Jones, who was killed, was a son of David Jones, of Titusville, Pa., an old English engineer connected with the New York, Pennsylvania & Ohio Railway and the Pennsylvania Petroleum Railway. The young man's brother is Chief Engineer of the Cleveland, Coshocton & Straitsville Railway.

THE NEW YORK AND BROOKLYN BRIDGE.

(*Continued from page* 183.)

After about one week's work the canisters were made of shells of cast iron, with sides one-half inch thick. One advantage of these was that they would drop to the bottom of the hole of their own weight. After a thorough blasting the dredge would work to advantage for some time. Bowlders too large for the dredge to handle were slung under water by divers, and either raised or floated under water beyond the inclosure. One thousand one hundred and seventy-three blasts were fired, consuming 13,000 pounds of powder.

THE CAISSON IN POSITION.

On May 1, 1870, the site having been leveled, the caisson was towed down from Greenpoint, a distance of five miles, by six tug-boats, and on the following day was warped into position. By June 20 the ten courses of timber previously mentioned were laid, and fastened at every intersection by a drift-bolt seven-eighths of an inch in diameter. As the courses were built up the outer ends were stepped back and covered with concrete five feet in thickness, which served as a protection against worms. Additional sections of water and air-shafts were put on, and an air communication established through the supply pipes.

The air-locks were seven feet high and six feet six inches inside diameter. The insides were of half inch boiler plate and the heads of cast-iron; six bull's-eyes lighted the interior. To avoid lengthening the air-shafts the locks were placed on top of the timbers, within water-tight compartments which occupied the spaces of the well-holes in the tower, and served to keep out the water when the timber was submerged.

BOLTS.

In some of the roof-courses of both this and the caisson on the New York side, the number of bolts starting in the course and passing through one or more courses below was about 5,000. Aside from this there were other bolts coming into the course from the courses above, to the number of fully 10,000. It will be seen, therefore, that great care had to be taken in arranging them to prevent interference and the endless trouble that would then be caused.

As the timbers were laid in courses, alternately crosswise and lengthwise, the most natural plan was to place the bolts in lines at right angles to the streaks. The timber was found to vary so much in width that if the bolts were placed anywhere near the center of the streaks it would be impossible to preserve the lines, and interference would ensue. It was found that by driving the bolts in diagonal lines no difficulty would be encountered.

It was observed that to keep the timbers in place after dogging, wedging, etc., it would be necessary that every stick should have at least one drift-bolt every four feet. The bolts were simple bars of iron, about 31 inches long, ⅞ inch thick, and slightly rounded at the lower end by hammering cold. The holes were bored $\frac{1}{16}$ of an inch small for the first half, and $\frac{1}{8}$ inch small for the lower half, and it was found that a bolt driven in this manner would hold almost to the point of rupture before it could be drawn. The arrangement was such that when the caisson was completed there was at least one bolt through every intersection of timbers.

To insure tightness of the screw-bolts rubber washers, with slightly cupped iron washers to hold them in place, were used under the heads and nuts. The plan pursued in the New York caisson was found to be more effective. That caisson was lined with iron, and the holes were slightly countersunk; this, with the capped washers, hemp grummets and red and white lead insured tight work when carefully done.

MACHINERY.

During the month of April, 1870, there were placed in position six air-compressors, manufactured by the Burleigh Rock Drill Company. Each engine was twenty horse-power, and drove two single-acting air-cylinders of 14 inches stroke and 15 inches diameter. The engines were independent. A large condenser precipitated the moisture in the compressed air, and delivered it dry into the caisson. The air was cooled in the pumps by the injection of a fine spray of water into the cylinder at every stroke. A 10-inch main, 150 feet long, carried the air under ground to the caisson, where it branched, and two rubber hose, six inches diameter, led it to the supply shafts and thus into the caisson. Although all the hose had been tested to a pressure of 60 pounds, self-acting clack valves were placed in order to to prevent the escape of air in case of accident.

MASONRY.

Eleven courses of masonry were laid, averaging from 24 to 28 inches high, each course containing from 700 to 800 cubic yards, the size of the stone varying from 30 to 100 cubic feet. The masonry of the first seven courses was composed of rough blocks of Kingston limestone. The stones were rectangular in shape, with the vertical faces trimmed down so that the joints would not be more than four inches wide when laid in the wall. They were set in heavy beds of cement and all the spaces filled with either cement or concrete—the latter when the spaces were large enough to admit it. As the low-water line was approached, granite was substituted on the face in place of limestone, the latter being continued for backing.

The stone-setting machinery consisted of three boom-derricks, standing on the masonry, with masts 55 feet high, and 35 feet horizontal booms, which controlled all points of the work. The guys were secured outside, and were regulated from time to time as the work advanced.

The stones were raised by two engines placed on shore, each working three drums, governed by friction gearing.

WORK IN THE CAISSON.

On the 10th of May, 1870, the air-chamber was first entered and explored. Removing the temporary wooden compartment, clearing away trap-boulders and all loose material from under the edges, and cutting doorways through the main division frames, occupied several weeks. During

this period there was much trouble caused by the rising and falling of the caisson with the tides, and it was not until three courses of masonry had been laid that this ceased.

At this time the force of men was 100, and work was carried on continuously.

Nine-tenths of the bowlders were trap, in sizes varying from one cubic foot up to 250. Boulders of quartz and gneiss rock occurred more rarely, and the softer varieties of rocks had been worn down to pebbles. A collection made of the various specimens encountered during the descent of the caisson presents a complete series of the rocks found for 100 miles to the north and northeast of Brooklyn.

The adoption of a regular system for uniformly lowering the caisson was a matter of much experiment at the beginning. No amount of pressure could force the bearing surfaces of it through the ground without crushing the cast-iron shoe at the cutting edge, or mashing the bearing frames. It therefore became a matter of great importance to dislodge all boulders lying in the course of the frames. The magnitude of this work may be conceived when it is remembered that the combined length of the outer cutting edge and the five frames was 1,050 feet. The shoe being of necessity unsupported, all that portion of the weight of the caisson which was not balanced by the air came upon the frames.

The plan that was adopted for lowering the caisson and that was pursued to the end consisted in supporting the frames every eight feet on two wooden blocks, 12 inches square and two feet long, one above the other, with four stout oak wedges interposed between the blocks and the bottom of the frame. A continuous trench, two feet deep and four feet wide, was thus maitained under the frames, giving ample working room for the removal of boulders. Whenever the shoe had been cleared out for six inches in advance, these wedges were then loosened with sledge hammers, one by one and frame by frame, until the caisson slowly settled. Then either new blocks were inserted alongside, of a smaller size, or, as was usually the case, they were allowed to crush. Very often a sudden descent of the caisson would crush half the bearing blocks, until arrested by the shoe. The operation was analagous to the splitting out of blocks and wedges during the launch of a ship.

The bottoms of the frames were originally two feet in width, but as this was too great to allow of the easy removal of rocks from beneath, it was reduced to one foot.

REMOVAL OF BOULDERS AND EARTH.

Boulders occurring inside of a chamber were generally left undisturbed until the caisson had sunk sufficiently to place them above the water level, when they were split into manageable blocks by plug and feather.

Boulders under the frame presented more difficulty. The ground in which they were imbedded was cut away with steel bars as much as possible; they were then drilled under water and a lewis inserted. To pull them from their beds was often an arduous task and frequently an unsuccessful one, until three hydraulic jacks—two of 10 tons and one of 15 tons capacity—were obtained.

After the caisson had been lowered about two feet it became possible to build dams around the trenches under the frames, and bail out the water. This brought the work into view, and materially lightened the labor attending it. These dams were shifted from trench to trench, care being always taken to leave an open trench leading to the water shaft. The removal of the water from the trenches was accomplished partly by hand bailing, then by air siphon pumps and steam siphon pumps, and, finally by the compressed air itself, throwing it entirely outside of the caisson through pipes introduced through the timber and masonry.

(TO BE CONTINUED.)

METHOD FOR DETERMINING THE CHARGES OF DYNAMITE FOR SLOPING ROCKS.*

Dynamite is now universally used in the construction of roads, tunnels, etc., but a great deal of difficulty has been experienced in determining the power of charges in proportion to the diameter and depth of the mining holes. Blasters are generally of the view that for a rock the mining holes should be filled from ⅓ to ¼, or from ½ to ⅔ of the

depth, according to the hardness of the rock, without taking into account the diameter of the hole. The consequence of this uncertainty is seen in the projection of débris to great distances in some cases, while in others, the expected results are not obtained. A practical method for determining the amount of charge is therefore of importance. The explosion of a charge of dynamite has the effect of breaking the rock which is comprised in the interior of a sphere of which the charge occupies

the center. We have therefore to determine the relation which exists between the radius S of this sphere, and the charge L. Now, practice as well as theory show that for the same explosive, acting on a given rock and under the same conditions, the charges are to themselves as the cubes of the radii of the spheres of rupture.

If we designate these charges by L, L_1, L_2, ... and these radii by S, S_1, S_2, ..., we may say:

$$\frac{L}{S^3} = \frac{L_1}{S_1^3} = \frac{L_2}{S_2^3} = ... = C.$$

The constant relation C is termed the *coefficient of rupture.*

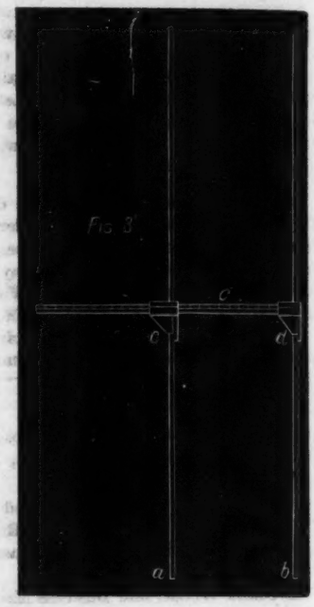
From the above equation the formula is deducted:

$$L = \frac{L_1}{S_1^3} \times S^3 = CS^3.$$

From which it is easy to determine the value (L) of the charge to be employed to produce a sphere of rupture of a given radius S.

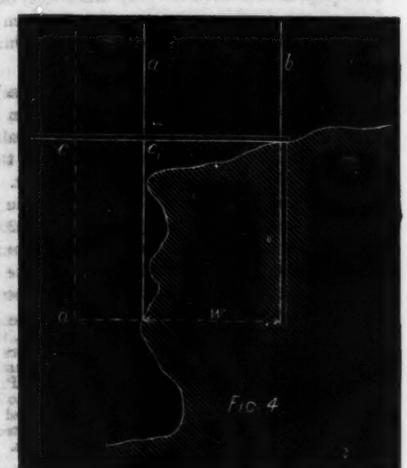
In case where we have simply to detach a block of a determinate size, as in quarrying, and not to disintegrate a mass of rock, the radius of the sphere of rupture must be equal to the line of resistance, w (fig. 1), that is, to the shortest distance between the bottom of the bore, or rather the center O_1 of the charge, from the side AB.

In this case the formula above given becomes



$L = Cw^3$, L representing the weight in kilos of the explosive materials; w, the line of resistance, expressed in meters and fractions of meters, and C the coefficient of rupture. This coefficient can be determined experimentally for each kind of rock and explosive by taking into account the effect which is to be produced.

Practice shows that holes of the same depth should be made, and that they should be so disposed that the lines of resistance should be equal. Different charges are then placed, and after the effect of the first, they may be increased or



diminished until the charge L is found. From the preceding formula we then find that $C = \frac{L}{w^3}$.

It is better, in order to simplify these calculations, to operate on holes having a line of resistance w, equal to 1 meter. Suppose, for instance, that experiments have shown that to obtain a satisfactory result on a certain rock, and on a line of resistance equal to 1 meter, we must use a charge of 0.500 kil., we have:

$$C = \frac{0.500 \text{ kil.}}{1^3} = 0.5.$$

and consequently: $L = 0.5 \times w^3$. The charges to be

*The above article is translated specially for ENGINEERING NEWS from the *Bulletin of the Society of Austrian Engineers.*

used for greater or less resistances than one meter can be deducted from this formula, and it can be found experimentally whether they produce the desired results. The numerous experiments which were made in the quarries of Woellersdorf Grinzing, in the vicinity of Oedenburg, in the demolition of the Loevel bastion at Vienna, and the fortification walls of Prague, have permitted a determination of the values of C which are to be introduced in the formulas when the different kinds of stone are to be blasted by means of the three varieties of dynamite.

The following table gives the value of those coefficients which are reduced, as can be seen, to six in number.

TABLE NO. 1.

NATURE OF STONE.	Dynamite No. 1, containing 75 p. c. of nitro-glycerine.	Dynamite No. 2, containing 45 p. c. of nitro-glycerine.	Dynamite No. 3, containing 30 to 40 p.c.of nitro-glycerine.
	C.	C.	C.
Very hard stone, old solid masonry, hard calcareous.....	0.3	0.5	0.6
Stone of medium hardness, granite and calcareous stone.....	0.2	0.4	0.5
Soft stone, freestone, argile schist.....	0.1	0.3	0.4

The results must, however, only serve as a basis for experiments which must determine the exact value of C applicable to the rock in question. These coefficients will enable engineers to calculate the charges when blocks have to be detached; that is, where the sphere of rupture is tangent to the side of the stone as in fig. 1. To avoid these calculations, however, we have brought together in table 2 the values in kilograms of the charges of dynamite corresponding to the values of C, above indicated, and to the lines of resistance w, varying from 0.25 to 2 meters.

TABLE NO. 2.

VALUE OF THE CHARGES OF DYNAMITE CORRESPONDING TO

A line of least resistances w of:	And to coefficient of charge C of:					
	0.1	0.2	0.3	0.4	0.5	0.6
m.	k.	k.	k.	k.	k.	k.
0.25	0.002	0.004	0.006	0.008	0.010	0.012
0.30	0.003	0.006	0.009	0.012	0.015	0.018
0.35	0.004	0.008	0.012	0.016	0.020	0.024
0.40	0.006	0.012	0.018	0.024	0.030	0.036
0.45	0.009	0.018	0.027	0.036	0.045	0.054
0.50	0.013	0.026	0.039	0.052	0.065	0.078
0.60	0.022	0.044	0.066	0.088	0.110	0.132
0.70	0.034	0.068	0.102	0.136	0.170	0.204
0.80	0.051	0.102	0.153	0.204	0.255	0.306
0.90	0.073	0.146	0.219	0.292	0.365	0.438
1.00	0.100	0.200	0.300	0.400	0.500	0.600
1.10	0.113	0.266	0.399	0.532	0.665	0.798
1.20	0.173	0.346	0.519	0.592	0.865	1.038
1.30	0.220	0.440	0.660	0.880	1.100	1.320
1.40	0.274	0.548	0.822	1.096	1.370	1.644
1.50	0.338	0.676	1.014	1.352	1.690	2.028
1.60	0.410	0.820	1.230	1.640	2.050	2.460
1.70	0.491	0.982	1.473	1.964	2.455	2.946
1.80	0.583	1.166	1.749	2.332	2.915	3.498
1.90	0.686	1.372	2.058	2.744	3.430	4.116
2.00	0.800	1.800	2.400	3.200	4.000	4.800

Where large masses of rock, the base of which has been mined, as shown in fig. 2, the holes have strong lines of resistance. To have the charges produce their full effect we must calculate them so that the great circle of the sphere of rupture will pass beyond the surface of the rock side. To obtain the best result the quantity r (fig. 2) must be equal to the line of resistance w.

In this case we have $S = \sqrt{w^2 + r^2} = 1{,}414\ w$, and the general formula becomes:

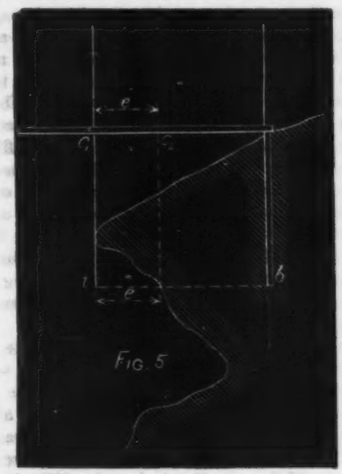
$$L = CS^3 = 2.83\ Cw^3.$$

From this we arrive at the conclusion that for blasting masses of compact rock, sinking wells in mines, etc., we must calculate the charges by giving to the coefficient of charging three times the value, as in case of rocky masses with vertical side as are presented in railroad cuttings.

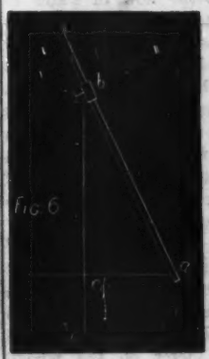
Capt. Lauer has constructed two very simple apparatuses for measuring the lines of resistance and determining without calculation the number of cartridges or half cartridges necessary.

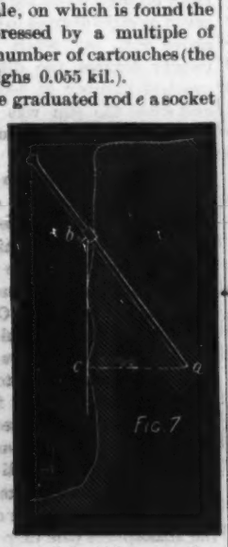
The charging apparatus for vertical holes, or almost so, is composed of two round rods a and b, formed of two parts united by means of a brass rod, so as to carry them about with more facility. Each rod is divided into parts of ten centimeters (fig. 3).

The apparatus is completed by two other rods with triangular section e which are placed horizontally. On each of their faces, corresponding to the six values of the coefficient of charge C given in the table No. 1, is a scale, on which is found the value of the charge expressed by a multiple of 0.055 kil., that is, by the number of cartouches (the commercial cartridge weighs 0.055 kil.).



At one of the ends of the graduated rod e a socket d is screwed, in which the rod b slides; another socket c allows the rod a to slide parallel to itself so as to separate it from the rod b, or to lower or raise it. The method of using the apparatus is as follows: If a stone of moderate hardness is to be blasted, No. 3 dynamite is taken. The coefficient of charge in this case is equal to 0.5 (table 1); the apparatus is placed so that the face of the rule e occupies the upper part. The rod b is then put in the hose. The rod a is slid along the horizontal rule until it (the rod) is tangent to the side of the rock. Finally, the rule C is put down until it touches the mouth of the hole. In C_1, we find the number of cartridges required for blasting the rock.





If the surface side of the rock (fig. 5) is of such a shape that the lower end of the rod a cannot come in contact with it, it is then very evident that the charge marked in C_1, would be too strong. In this case, we must measure the distance e and carry it forward from C_1 to C_2, where the proper charge will be found.

The second instrument is for calculating charges where the holes are inclined. It consists of a round rod, a, divided into decimeters (fig. 6), and along which an articulated socket can be moved with a rod bc. The lower end of the rod a has a groove in which the end of a sheet-iron strip, ad, can be inserted. We have thus a movement of three strips of metal, each having a scale corresponding to the three values of the coefficient of the charge C (table 1).

The apparatus is used as follows: When a rock of medium hardness has to be blasted, the coefficient of the charge being 0.5, the rod ba is inserted in the hole (fig. 7). The socket b is advanced until the upper end of the rod bc comes on the mouth of the hole; then the tringle is applied vertically along the side of the rock. The socket is then screwed so as to fix the two rods in their relative position. The instrument is then withdrawn and the end of the strip of sheet iron, which has the scale corresponding to the coefficient 0.5, is inserted in the groove in the end of the rod ba, and it is placed perpendicularly to the rod bc (fig. 6): at the point of intersection c, will be found on the scale of the strip ad the number of cartridges. Miners using these instruments save from 20 to 25 per cent. of dynamite.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 184.)

XVI.—DETROIT.

Detroit, Michigan, is on the west bank of the Detroit River, 18 miles from Lake Erie and 7 miles from Lake St. Clair, in lat. 42° 19′ 53″ N., long. 82° 58′ W. The ground rises from the river at the rate of about 58 ft. to the mile. The site was settled in 1701 by the French, occupied in 1736 by the British, and in 1787 by the United States Government.

The soil on which the city is built is for the most part a stiff clay, impermeable to water. As population increased, the yield of the wells which were dug was neither good nor abundant, and at an early day water was supplied by carts and buckets from the Detroit River, and every one was obliged by ordinance to keep on his premises a cask containing a certain amount of water, and so fitted that it could be easily handled in case of fire.

In 1824, the population being about 1,000, Peter Berthelet was authorized by the Legislature to build a wharf at Randolph street on condition of his erecting a pump on it, the water of which should be free to all residents of the city.

The pump was so erected and was used until May 19, 1835, when it was removed by order of the Common Council.

In 1827, the population being 1,500, Rufus Wells, under an ordinance of the Common Council granting him the exclusive right of supplying water, built a pump house on Berthelet's Wharf 20 ft. square with a cupola 40 ft. high, in which was a forty-gallon cask, into which two pumps of 5 in. bore, driven by horse-power, raised the water, which flowed thence through 4½ in. bored logs to a reservoir 16 ft. square and 6 ft. deep, built of 2-in. plank calked, and standing on a timber frame 16 ft. high, from which it was distributed through 3¼-in. bored logs. Families using water were charged $10 per annum, payable quarterly in advance.

In 1829, the Hydraulic Company, consisting of Wells and others, spent $6,000 in boring a 4-in. hole 260 ft. deep, from which no water was obtained.

In 1830 the company was authorized to supply water until 1865, the works to be then bought by the city at a valuation, and this charter was ratified by the Legislature, March 2, 1831.

*Copyright, 1881.

A 10 H. P. engine, driving a rotary pump, raised the water through a 3-in. iron pipe to a brick reservoir on Fort street, 18 ft. square and 9 ft. deep. The city was supplied through two lines of 3-in. logs, most of which, not being laid deep enough, froze up in 1830-31 and were relaid deeper.

In 1831 a second reservoir, 40 ft. square and 10 ft. deep, was built of oak plank adjoining the brick reservoir, and an inclined engine put up, with 12½-in. cylinder of 72-in. stroke, driving at first the rotary pump, but afterward a double-acting force-pump of 11-in. bore and 72-in. stroke.

On June 4, 1836, the company had expended $23,608 more than their receipts, and the city purchased the works for $20,500. A new reservoir, a duplicate of that of the Manhattan Company in New York, being an iron tank 60 ft. in diameter and 20 ft. deep, on brick walls, was built in 1837-8, after the plans of Noah Sutton. The castings were made from the patterns of the Manhattan Company in New York City.

The dock was extended and a direct-acting engine, with 20-in. cylinders of 96-in. stroke, and pump of 18-in. bore, and 96-in. stroke, was erected, which, in June, 1841, pumped water into the new iron reservoir, whence it was carried by 10-in., 4-in. and 3-in. iron pipe to the Fort street reservoir. No overflow had been provided to the tank, and in March, 1854, a tell-tale pipe being stopped during the night, the tank was pumped to overflowing, after which an 8-in. pipe was connected to it 18 in. below its top, and led 400 ft. to the river.

In November, 1854, to connect an additional 24-in. main, a coffer dam was made of a tub 10 ft. in diameter, and 6 ft. high, made of 3-in. staves, hooped, and coated with tar, around the outside bottom of which a 2-ft. bank of clay puddle was laid, which was protected by a canvas apron tacked to the tub, laid over the puddle, its lower edge being doubled over and stitched, forming a bag which was filled with sand. The tub was weighted down and the pipe connection made by cutting out the tank bottom inside the tub, the water outside being kept 5 ft. deep to keep up the supply to the city. The tank was removed in 1866.

The old engine and pump were abandoned in 1841, and in 1842 the Fort street reservoir was removed. In 1849 the consumption had so increased that the engine had to run from 16 to 24 hours a day, and on Nov. 19, 1850, a horizontal engine of 150 H. P. and a new engine-house inclosing the old one were put in use.

The inclined engine was replaced on a new foundation and repaired. There were at this time 4½ miles of iron pipes, the largest being 10 in. in diameter, and 35 miles of wooden logs, mostly of 2-in. bore, laid regardless of system. On Feb. 24, 1852, the control of the water-works was vested in a Board of five trustees, and in May, 1853, the Board of Water Commissioners was created by the Legislature.

At this time trouble began to be experienced from pollution of the water. The inlet pipe of the first engine extended 12 ft. beyond the dock, and that of the second 25 ft. When the works were first built a sluice was cut across the dock, and the shore current, with its impurities, passed through it.

As the shore became occupied above and below, the building of other piers and the creation of basins in which timber was held by booms, obstructed the shore current, the sluice gradually silted up, and the impure littoral current passed outside of the pier and over the inlet pipes.

A 30-in. inlet pipe was laid 150 ft. out into the river, protected by piles cut off and filled around with stone, and was brought into use Aug. 28, 1858. On the river end of the pipe there is a bell-shaped mouth elbow, turned upwards, the end of which is 36 in. in diameter, over and surrounding which there is a strainer, also made of boiler-iron, 9 ft. in diameter and 10 ft. high. Above the end of the pipe the boiler-plate in the strainer is perforated with half-inch holes, one hundred and forty-four to the square foot. Surrounding the mouth of the pipe, and inside the shell of the strainer, there is a diaphragm plate with similar holes. Below this diaphragm plate, the shell of the strainer has 4-in. holes to allow the sand to pass through, so as not to bank up on the outside of the strainer. When the engine is pumping, the water is required to pass through the holes in the strainer at the rate of 120 barrels per minute, to furnish a full supply. The water is 25 ft. deep over the top of the strainer; the current of the river about 3 miles per hour. Under certain circumstances during extreme cold weather, it was with difficulty that a supply of water could be obtained, in consequence of the accumulation of ice on the strainer frequently requiring the speed of the engine to be reduced, and at times to stop it for several hours together, no water passing through the pipe into the well, notwithstanding the bottom of the well is 12 ft. below the surface of the river.

The well is about 40 ft. long, 18 ft. wide, and 12 ft. deep. The circumstances under which the difficulty occured when the weather was cold and the ice was forming in the lake above, and on the shores of the river, and the river was free from ice over the strainer. But when the river was covered with ice over the strainer the difficulty did not occur at any degree of cold. The greatest difficulty occured when the thermometer ranged from seven or eight degrees to eighteen or twenty degrees above zero, but when the mercury rose above twenty degrees the difficulty soon ceased. The greatest number of detentions occurred at night, and when the sun was obscured by clouds, but when the sun was unclouded no difficulty was ever experienced.

This peculiar stoppage to the flow of water to the pump-well was encountered for many years, first on the strainer of the inlet pipe laid in 1840, again on the one laid in 1850, both of which were located so near the wharf that ice formed in them was removed by means of long poles kept at hand for the purpose. On the new pipe when ice formed as before, it could not be so removed, and all that could be done was to wait for the action of the elements on the ice to remove it, which usually took from three to four hours.

A committee reported that on the 20th of December, 1867, while but a small supply of water could be procured, a diver went down to the strainer and made an examination of its condition.

Owing to the extreme coldness of the water and the atmosphere (the thermometer on the wharf marking 26° Fah.); it was impossible for him to remain down but for a short time, but long enough to discover the fact that the strainer, with its surrounding piles, was one mass of ice particles, collected into a mound some 10 ft. high, and about 15 ft. in diameter, and that large quantities of minute crystals of ice were rapidly passing and adding to the mass already collected. Specimens of the ice were brought to the surface in a bag. It was in sheets and particles thin as paper, translucent, with sharp-pointed edges.

A further examination developed the fact that the small amount of water the pump was then receiving came through the lower or down-stream side of the strainer, this being the only point where he could approach it, and which was found but slightly covered with ice.

The strainer was then inclosed with canvas except the down-stream side. This was but just completed when the weather became colder, and during the night the thermometer indicated several degrees below the freezing point, and before daylight the engine stopped for want of water. Preparations were made as speedily as possible for another descent to the strainer.

At 11½ o'clock a. m. the diver went down, and it was ascertained, that with the temperature of the atmosphere at 29° the water at the surface was 33°, while at the bottom of the river it was 35°. At this descent much less ice was found on the strainer and its surroundings than the first time. The lower side was clear, but on the upper side the action of the current had worn the ice into elongated cones, pointing up stream. At this time the pump was receiving a full supply of water.

About three hours later the diver again descended (thermometer, 33°). He found the ice had entirely disappeared. No trouble was experienced up to Jan. 24, when the surface ice of the river was in motion. From 1 o'clock a. m. of the 25th (thermometer, 16°) no water could be obtained until daylight, when the engine was again started, and no further delays occurred.

A new 36-in. inlet pipe of ¼-in. boiler iron, with flexible joints, was placed in 1873. There are four strainers all on the down-stream side. On the outer strainer is a door at the top, opening by a rod from the shore to enable water to be taken if the strainers become obstructed.

The second engine was altered in 1861 into a condensing engine with a 29-in. cylinder and 96-in. stroke. A "pair of square engines with double bucket pumps so arranged as to produce a continuous flow of water in one direction, with a guarantee of a duty of 150,000 lbs. per lb. of coal" were erected in 1856–61.

In February, 1861, they were started and ran a few times and were abandoned, the contractors, Messrs. Dickerson and Sickles being unable to make them work.

A direct-acting engine of 42-in. cylinder and 96-in. stroke, with pump of 24-in. bore, was erected after the plans of John E. Edwards, and began running in December, 1863.

An engine of 18 million gallons capacity, after plans of J. E. Edwards, began running in 1871.

A reservoir was built 1854–8, 4,500 ft. from the river.

Its water surface was 77.5 ft. above the river and was in two divisions each 200 ft. square. The earth embankments 30 ft. high were paved with brick on edge on the inner slopes.

The reservoir was used after November, 1857, while the banks were in progress of construction, the water being kept below the unfinished work.

The banks showed signs of settlement soon after the reservoir was filled. On drawing off the water from the west basin the inner slopes slid in. They were repaired and covered with slope walls of dry stone.

The slopes of the east basin were relaid with stone also, and it was brought into use in June, 1860. This reservoir, which holds ten million gallons, is still in use, and is the only distributing reservoir. It is in good condition.

The distribution service was for many years of wooden logs, as has been stated. In 1852 there were 27½ miles of logs and only 4½ miles of iron pipes.

For fire service, reservoirs in the streets were made, which were filled when a fire occurred by kicking out a wooden plug in the pipe connecting them with the mains. In 1854 it was reported that they were being fitted with stop-cocks, as the plugs were liable to be lost, and besides when they were replaced by driving them in against a head of water the "operator was pretty sure of a good wetting."

Many logs were laid by individuals, with permission of the Common Council, and paid for in water furnished. Some of these were from 1 to 2 ft. be-

low the surface, and in severe winters froze and burst.

In 1856 more than four miles were entirely destroyed in this manner.

From 1852 to 1857 all pipes laid were of iron. In 1857 the use of logs was resumed, for reasons of economy. Good logs well laid had lasted 16 years. Their cost was one-fifth that of iron pipes. Assuming a life of 20 years for the logs, it was estimated that the growth of a street in that time would produce a revenue equal to the cost and interest of the wooden pipe, and enable iron pipe to be laid for permanent supply.

A boring machine was procured, and pipes manufactured by the commissioners for their own use.

The logs were required to be of sound green tamarack not less than 6 in. in diameter at the smaller end, and 8 ft. long. The joints were covered with iron thimbles and the pipes laid 5 ft. below ground.

The use of wood pipe has been continued to the present time, but at a diminishing rate. A mile and a half was laid in 1880 and two and a half miles taken up and replaced with iron pipe. Pipe of small size are used to a greater extent than in most other cities. The 84¼ miles of wooden pipe are from 2½ to 4 in. in diameter, and of the 124¾ miles of iron pipe, 56 miles are of 3 and 4 in. diameter.

New pumping-works were completed in 1877, situated 4 miles farther up the Detroit River, after the plans of D. Farrand Henry, C. E.

A pipe, 5 ft. in diameter, extends 1,100 ft. into the river, the outer end lying on the river bottom, 22 ft. below the surface, in a crib, and the shore end being in a settling basin, 800 ft. by 365 ft., with solid clay bottom. From the basin a brick conduit leads to the pump-well. The sides of the basin are formed of plank walls supported by piles and backed with 14 ft. of puddled clay. The basin is 13 ft. deep at the river end and 17 ft. deep at the conduit end. At 75 ft. from the river end is a submerged weir which prevents a direct current from the inlet to the outlet.

A compound vertical beam engine with high-pressure cylinder of 42-in., and low-pressure of 84-in. diameter, both having 72-in. stroke, and double-acting pumps of 40¼-in. bore and 72-in. stroke, pumps into a stand-pipe.

Another compound engine with high pressure cylinder of 46-in. and low-pressure of 84-in. and pumps 41 in. in diameter and 72-in. stroke was erected in 1880.

The population, pipeage and consumption have been as follows:

Year.	Population.	Miles pipe.	Daily consumption in millions of gallons.
1853	28,268	13.6	0.83
1860	45,619	63.	2.38
1870	79,757	129.5	5.11
1880	116,342	209.	15.17

The use of meters was begun in 1876. On Dec. 31, 1880, there were 17 in use and 12 elevator indicators.

Jacob Houghton, Jr., was Engineer and Superintendent from 1852 to 1860.

John E. Edwards has been Engineer of the pumping-works since 1860. D. Farrand Henry was Chief Engineer from 1870 to 1877.

According to the report for 1880, the estimated value of the works Jan. 1, 1881, is $2,750,700.39.

Since 1853, the total receipts from water rents have been $3,080,393.09.

The outstanding bonded indebtedness is $1,503,000.

XVII.—PROVIDENCE.

Providence, R. I., in lat. 41° 49′ 22″ N., long. 71° 24′ 48″ W., at the head of navigation on Narragansett Bay, 35 miles from the ocean, covers an area of 14.76 square miles. Two small rivers meet in the centre of the city, and on its east side the Blackstone River near its mouth becomes a wide tidal basin called the Seekonk River. The confluence of these streams forms the Providence River.

The site is topographically divided into three plateaux. The first, in the neighborhood of the river and comprising the business portion of the city, is about 10 ft. above tide level. The second, a large district on both sides of the river, the level of which may be called 75 ft. above tide. The third, a small district, from 90 to 200 ft. above tide.

Settled in 1636 and incorporated as a city in 1832, the population in 1870 was 68,904; water-works were constructed by the city, after the plans and under the superintendence of J. Herbert Shedd, C. E. The source of supply is the Pawtucket River, which has a watershed of 192 square miles, and empties into the Providence River 5 miles below the city. About 4 miles from its mouth, the Pettaconsett pumping station is situated.

A basin was excavated in the porous and saturated sand near the river bank, and provision also made for drawing directly from the river.

A Cornish beam engine of 100-in. cylinder and 132-in. stroke was erected. Pending its erection a Worthington engine of five million gallons capacity was put in use, taking its supply directly from the river, and began running in November, 1871, and water was introduced into the city on Nov. 30.

The Cornish engine began pumping in July, 1876. This engine is placed on one end of a timber platform, 4 ft. thick, lying on saturated sand. Its use caused a settlement of the end on which the beam walls, side walls of the engine-house, the pump and the stand-pipe rested. The foundations of the Cornish engine continuing to settle, it was decided, on th advice of S. M. Gray the City Engineer, to drive piles through the timber foundation, both under the pump and around the stand-pipe. Before commencing the work a test-pipe was driven through the foundation to the depth of 61½ ft., without reaching solid or hard bottom.

For about 25 ft. the material was about equal to coarse mortar sand, and below that was found the worst kind of quicksand of a quagmirish character.

The pump was removed, and sixteen piles, 10 in. in diameter, were driven through the foundation to a depth of about 25 ft., holes having been cut by a boring machine made for that purpose. These piles were securely fastened to the timber foundation so that there can be no upward or downward movement of the platform without working the piles in the sand, and were so located that when the pump was returned to its position its base rested upon the ends of the piles and also the timber platform.

Twenty-four piles were also driven around the stand-pipe, and through the platform where there had been the most settling. These were of the same diameter and were driven to about the same depth as those under the pump, and were also securely fastened to the platform, so that there can be no movement either up or down without moving the whole 40 piles.

At the commencement the pile was driven from 6 to 10 in. at one blow, and in driving the last ones the piles were settled only from ½ to ¾ of an inch at each blow, from a hammer weighing about nineteen hundred pounds, and falling upward of 20 ft. This fact, together with the one that a portion of the platform with all its weight was raised by driving the piles, is evidence that the sand must be packed very hard. So far as can be seen, there has been no change in the foundations since the above-named work was completed, and it is believed they have been permanently secured.

The work was begun Sept. 22, 1879, and the engine began pumping again on Nov. 26.

The water is lifted 180 ft. into Sockanosset reservoir, which has a water surface of 11 acres and a capacity of 51 million gallons.

It is in excavation and embankment of earth. The slopes are lined with 6 in. of broken stone, on which is laid a dry wall of stone 15 in. thick.

The high-service pumping engines (called the Hope engines) are intended to supply an almost constantly varying demand for water, by pumping into the mains directly. They receive their supply through the low-service mains, the water reaching the pumps under a head, on the suction side, varying about 40 ft. The average lift is 88 ft.

The first engine was erected in 1874 by G. H. Corliss. It has five cylinders of 20-in. diameter and 30-in. stroke.

A second high-service engine, after the designs of the Providence Steam Engine Company, was put in operation in 1876. It is a compound vertical engine, with steam cylinders 11 and 19 in. diameter and and 42-in. stroke.

The main shaft is led off on the high-pressure side and carries a fly-wheel, and also a pinion which communicates motion to the pumps through a gear-wheel on another crank-shaft. There are two horizontal pumps of 17-in. bore and 48-in. stroke. The engine makes five strokes to one of the pumps.

The Hope high-service reservoir is 102.5 ft. above high tide, is of irregular shape, about 950 ft. long and 840 ft. wide and 24½ ft. deep. Its capacity is 80,000,000 gallons. It was put in use in October, 1875. Distribution pipes are of cast-iron.

The population, pipeage and consumption have been as follows:

Year.	Population.	Miles pipe.	Daily consumption in millions of gallons.
1872	76,093	70	0.90
1879	101,255	152	3.11

The use of meters began at once, and there were on Jan. 1, 1880, 4,036 in use. The number of takers was 8,656.

For construction a board of three commissioners was appointed by the Common Council.

For management in February, 1874, three commissioners were elected by the Council, and held office until November, 1876.

The works since that time have been managed by three commissioners, one of whom is appointed by the council each year.

The works were designed and constructed by J. Herbert Shedd, C. E. On his resignation in March, 1877, Samuel M. Gray, the City Engineer, became Superintendent of the works, and still holds that position.

The cost of construction to June 1, 1880, was	$4,679,355.90
For maintenance	382,531.15
Total, exclusive of interest	$5,061,887.14
Revenue to June, 1880	1,646,700.98

[TO BE CONTINUED.]

We have received the sixth, seventh, eighth and ninth Annual Reports of the Superintendent of the Water-works of Bay City, Michigan, from E. L. Dunbar, Superintendent and Secretary. From Louis Le Sage, Superintendent Montreal Water-works, Annual Reports for years 1877, '78, '79, '80. From R. K. Martin, Chief Engineer Baltimore Water-works, Statutes and Ordinances, with decisions relating to Water Department in force August, 1877; Annual Reports for years 1877, '78.

We beg leave to acknowledge the receipt of Manuscript History of Water-works of Bay City, Mich,, from E. L. Dunbar, Superintendent; Evansville Water-works; Report of the Expert in the Contract Trials of the Gaskill Compound Pumping Engine, built by the Holly Manufacturing Company, of Lockport, from Jno. W. Hill, M. E.

CORRESPONDENCE.

POCKET TABLE BOOKS.

GREENVILLE, Mich., May 10, 1881.

EDITOR ENGINEERING NEWS :

In regard to a pocket table book, it is my opinion that a book containing logarithms, log. sines and tangents, nat. sines, tangents and versed signs, table of latitude and departure, and radii mid. ordinates and deflection and tangential distance, and none others, would meet a larger sale than any other for the reason that it is rare that a surveyor will use any other table in the field.

I have carried Scribner's book for 25 years, and half of it is filled with tables that I have never used in the field. H. M. CAUKIN.

CEMENT MORTAR.

URBANA, Ohio, May 10, 1881.

EDITOR ENGINEERING NEWS :

Will not some of your contributors, who have had considerable experience with mortars and cements, in situations where the absorption of moisture has almost if not entirely ruined walls and arches, give us, through the columns of ENGINEERING NEWS, an article stating the conclusions they have reached in regard to the best methods of constructing stone-work? The crumbling and giving away of bridges and culverts, especially on improved roads, show conclusively the need of more information in regard to such matters. County surveyors, in the superintendence of the construction of road improvements, need all the light they can obtain.

BENJAMIN THOMPSON,
County Surveyor.

AN ANSWER TO AQUARIUS.

ST. LOUIS, May 10.

EDITOR ENGINEERING NEWS :

Let x = height of water in tube D from bottom.
Let y = height of water in tube B above level of E.
Let a = multiple that air in BC is increased in volume.
14.7 = atmospheric pressure.
0.433 = weight of 1 ft. of water, 1 sq. in. in section.
5.57 = length in ft. of bend in top of BC.

The pressure at center of C and D is given by this equation :

$$14.7 + 0.433\,x = (9 - x)\,0.433 + \frac{14.7}{a}.$$

Again, since pressure at level of E in tube B is equal to that at E in tube A, we shall have

$$0.433\,y + \frac{14.7}{a} = 14.7.$$

Lastly, taking sum of lengths,

$$y + 5.57a + 9 - x = 12.57.$$

Solving we shall obtain

$$a = 1.046 \text{ ft.}; x = 3.753 \text{ ft.}; y = 1.495.$$

BILLEE TAYLOR.

PUBLIC WATER-WORKS.

NEW HAVEN, Ct., May 9.

EDITOR ENGINEERING NEWS :

As you have kindly invited criticisms on the subject of public water-works, with reference to publication if found worthy, the opportunity is availed of to say a few words about water-pipes.

So far as now appears, cast-iron pipe dipped in coal tar is becoming of general use, owing to the fact, perhaps, that with the expiring patent, known as the "New Jersey Cement Pipe," the life of the pipe itself is being criticised.

By way of contrast, to get at a fact, let us ask any first-class plumber if he would adopt and put in a service pipe made of wrought iron and dipped in coal tar, through which to draw water into houses for family use?

We venture the answer, that not a single first-class plumber would use such a pipe for such a purpose.

If, then, they would not use it as a service pipe, how about it for main pipe, either drawn or *cast iron* and dipped in coal tar?

It is evident that we are not altogether right in this country as to water-pipes; a wide field, therefore, is open for experiment and utility.

Cast-iron pipes will oxidize inside and outside, and constantly diminish in discharging capacity, and the tar lining is but temporary and flavors the water more or less until it is worn off; and as for average, the lifetime of cast-iron pipe is not much greater than that of the pipe known as "New Jersey cement pipe," if the latter is well made.

Water-works are under ground and out of sight, therefore all we know of them are leakages, bursts, giving outs, poor water at times, and expense *all* the time, so that more cheating and deception can be and is practiced in their construction than in any other kind of public works.

ENGINEER.

NOTE ON LEVELING.

PATTERSON, N. C., May 3, 1881.

EDITOR ENGINEERING NEWS :

A note on "level rods and leveling," by Mr. Leavenworth, C. E., in your issue of April 23, calls for some comments.

Leaving to one side Mr. L's. design for a level rod, which is unsuited to a hilly country, where sights *not less* than "50 feet" are not always procurable, I proceed to note some consequences resulting from the use of the "Height of Instrument" method, preferred by him.

As mentioned by me in ENGINEERING NEWS of April 2, *there is no check on the elevations of intermediates by this method*, so that any number of them may be wrong without the leveler being aware of it. This cannot be denied, for it is a fact of daily experience. Those engineers who use this method are compelled then to resort to a recomputation as the best substitute for an independent check that can be afforded.

If this be so, by what logic can Mr. Leavenworth arrive at the conclusion that the "H. L." method gives "an equal chance to test the work," as the well known "B. S. and F. S." method, *that gives a double check on both intermediates and turning points?* It is true that by copying off the rod readings on turning points, and proceeding in the way mentioned by Mr. L., the elevations of the turning points are checked *once*, but this is not generally sufficient. Besides, a perfect form of level book should contain everything in it necessary to make the computations and check the work thoroughly, without resorting to figuring on "separate pieces of paper," which are not always at hand, and even when at hand are not so often used.

The consequences of mistakes in the levels—both intermediate and turning points—are so grave that it is well to call attention to some of them. Thus if any station elevation is wrong, the side-staking is wrong and the estimates erroneous. The result is more disastrous where culverts, trestles, or bridges are involved. It cannot be said that such errors do not happen, for in the experience of most, if not all, engineers they do happen where proper safeguards are not thrown around the computations. It is next to impossible to make these errors, using the double check I propose, embodied in the level book itself; so that there can be no excuse for the assistant, should he be wanting in separate slips of paper, in not having every elevation correct.

A railroad manager told me recently that three miles of grading, including some bridging, had to be thrown away, because the leveler had made a mistake on a maximum grade of 10 ft. in his levels—"of course in the wrong direction."

Supposing this mistake to have occurred in the notes, is it not altogether improbable that it would have occurred if a double check on the computations had been afforded?

Single checks *have* failed, and there should be the remotest possibility of failure in such important matters.

It is particularly necessary for new hands at the level to be afforded every safeguard that can be given.

Again, practitioners know that in running experimental grade lines, that the chief of party is continually calling to the leveler for *cut* or *fill*, in order to fit the maximum grade to the ground to the best advantage. A cut or fill given incorrectly insures the line to be incorrectly run until another call is responded to correctly. Such mistakes are matters of common experience.

By the method I propose, the error, if any was made, would be quickly detected and rectified.

Mr. Leavenworth thinks that elevations should not be made out in the field, but in the office, where the leveler "can sit down calmly with nothing else on his mind." How would it be possible, then, for the principal assistant to run a maximum grade line in the field? And such grade lines constitute the greater part of railroad lines. Here I am, for example, engaged in running a nearly continuous grade line through the Blue Ridge of two thousand feet total fall. How a single day's work could be done without constantly consulting a level I am at a loss to conceive.

In all parties that I have ever known, the leveler was required to keep up his notes in the field; and really there is generally an abundance of time for it.

The objection that the form I propose takes up too much space has never proved serious. The notes and grade column are all on one page—the cuts on the next page. In experimental lines the grades and cuts need only be made out to the nearest even foot occasionally, so that very little space is required for them. For estimates or side-staking, it is usual to copy off the elevations and grades in a separate book, where plenty of room is afforded. The disadvantage, if any, of the additional column—for the best form by the height of instrument method would contain only one less column than the other form—is far more than compensated by the nearly absolute certainty of the accuracy of the work, so that this form is earnestly suggested to the attention of all those engineers who desire the most perfect accuracy attainable. WM. CAIN.

THE PANAMA CANAL.

Ex-Secretary Thompson reports that the announcement of the defalcation in the Canal Company's funds was exaggerated. He is informed that the amount taken was $8,000 instead of $30,000, and the man was captured and $7,500 of it recovered. He says that the complaints about poor provisions came from the French engineers, who could not put up with the native diet, but that they had to adopt it, as the surgeons advised them if they did not use the food of the country they could not live in the climate. Mr. Thompson says they are progressing faster than was expected with the preliminary work of clearing off the trees and laying out the exact course of the canal. He expects that the excavation will be started by midsummer. He is having 700 portable houses constructed in this country, to be taken to the Isthmus and put up for the shelter of the men. They will also take down a large stock of all kinds of tools, including heavy steam shovels made in Boston for dredging and excavations. A narrow-gauge railroad will be run along the side of the canal to carry out the earth from the excavations to points where it is needed for purposes of grading. He is going to try an experiment with American labor, and will test the adaptability of negroes to the climate by taking out a colony of some five hundred blacks from the Gulf States. If these men do not stand it, he may employ Cuban coolies

ENGINEERS' SOCIETIES.

LIBRARY OF AMERICAN SOCIETY OF C. E.

AMERICAN SOCIETY OF CIVIL ENGINEERS,
127 East Twenty-third street,
NEW YORK, May 5, 1881.

DEAR SIR: The Committee on Library desire to call your attention to the Index to the Railroad Section of the Library, a copy of which has been sent you by mail.

The object of this Index is threefold:

First. To inform members of the Society of the contents of the Library, which has attained very respectable proportions and holds much that is valuable.

Second. To attract attention to the deficiencies in the sets of reports and documents relating to corporations, and induce members to send copies of the documents needed to make those sets complete and to make the Library what it should be, a full and complete collection of printed matter relating to American railroads.

Third. To aid members in the investigation of special subjects by furnishing them with a topical index of the current literature of these subjects.

The present issue will serve the two first-named purposes, and to a certain extent the third. What is now presented in the third division of the Index, viz.: "Subjects," will, it is hoped, be of assistance in enabling members to know exactly where to look for information on many points. To be thoroughly useful, this division must be extended to include the periodical literature named on pages 187 and 188 of the Index. To accomplish this, the co-operation of all the members is desired. What has been accomplished has been put into its present form by the Chairman of the Library Committee, with the aid of a few members working on the basis of the arrangement and card-cataloguing of the Library, which has been thoroughly kept up by the Secretary in addition to his other duties, occupying his time to such an extent that it was impossible for him to carry out the full scheme of making the Library useful to all without further assistance. Your aid is earnestly requested in the extension of this work, in the direction and manner in which it has been begun.

The Committee will be glad to receive from you answers to the following questions:

(1.) Will you contribute to the Library any reports or books relating to railroads?

(2.) Will you prepare a topical index of any volume or volumes you may possess of foreign or American periodicals other than those named on page 3? Or, if a resident member, will you undertake—whenever you can spare the time—the preparation at the Society Library of a topical index of one or more volumes of periodical literature?

If you will do this, cards and a letter of general advice as to the scope and style of the indexing will be furnished.

Such an index as is proposed cannot but be invaluable to all members, by enabling them to find precisely what they want if they visit the Library, or to send for the information definitely if they are at a distance.

It is proposed to issue another edition of the Index if this appeal is responded to as fully as is anticipated.

J. J. R. CROES,
O. CHANUTE,
ASHBEL WELCH, } Committee on Library.

Address replies to JOHN BOGART,
Sec. and Librarian.

AMERICAN INSTITUTE OF MINING ENGINEERS.

ANNOUNCEMENT OF THE VIRGINIA MEETING.

GENERAL COMMITTEE.—J. F. Lewis, Quinnimont, W. Va.

PROGRAMME.

Monday, May 30—Opening session in the Staunton Opera-house, at 8 o'clock p. m.

Tuesday, May 31—Sessions of the Institute at 9 o'clock a. m., at 3 o'clock and 7.30 p. m. At 1.30 p. m. an excursion will be made in carriages about the city, visiting the water-works and public institutions.

Wednesday, June 1—Excursion over the Shenandoah Valley Railroad, visiting the Shenandoah Iron Works, Luray Cave and other points of interest.

Thursday, June 2—Excursion over the Chesapeake & Ohio Railroad, visiting Ferrol, Longdale, Clifton Forge, Low Moor, and arriving at White Sulphur at 5.30 p. m. Session of the Institute at 8 p. m.

Friday, June 3—Excursion over the Chesapeake & Ohio Railroad to the New River coal fields, visiting Quinnimont, Stone Cliff, Fire Creek, Sewell, Nuttallberg and Hawk's Nest, where an opportunity will be given for an examination of the Ansted coal mines; then through the Kanawha coal fields to Coalburg, returning to White Sulphur for the night.

Saturday, June 4—Excursion over the Richmond & Allegheny Railroad from Williamson's to Balcony Falls, visiting the Natural Bridge of Virginia, returning to Williamson's in time to take the trains East and West.

Reduced rates of fare have been obtained from the Baltimore & Ohio Railroad from points on their line and it is expected that arrangements will be completed for reduced rates on other roads.

It is necessary that members should inform the Secretary of the Institute promptly of their intention of being present at the Staunton meeting, in order that certificates may be sent to them for the purchase of such excursion tickets as may be issued by the different railroad companies, and also that accommodations may be prepared for their comfort during the meeting.

Members are requested to give early notice to the Secretary of the papers they intend to present at this meeting, that they may be announced in a subsequent circular. It is expected that the discussion on steel rails, begun at the Philadelphia meeting, will be continued.

THOMAS M. DROWN, Secretary.

EASTON, Pa., May 6, 1881.

ENGINEERS' CLUB OF PHILADELPHIA—RECORD OF MEETING, MAY 7, 1881.

Mr. Frederic Graff occupied the chair; 31 members and two visitors were present.

Mr. Rudolph Hering, Assistant Engineer of the Survey Department, who recently made an examination of the sewerage works of the principal European cities, gave a general account of his trip. He sketched the gradual development of sanitary works, alluding to the indifference upon the subject in the middle ages, the consequent terrible epidemics, the slow development of the recognition of its importance, and to the present difference of opinion as to the proper methods, resulting in a great variety of design in the existing works.

He then described the various general designs in historical order and compared the efficiency of present methods. The same system and ideas will not be applicable to every town. The topography, physical features and the customs of the people may necessitate radically different plans. Rain water, in some cases, might be let off on the surface; in others, like Philadelphia, it must, to a great extent, be carried away in deep sewers. The "*separate system*," which is common in England, and has recently been partially executed for Memphis, is therefore not economical here, except in localities where the present sewers are found entirely unsuitable for the proper conveyance of house water and could be used for storm water alone. When the entire system is built anew "*the combined system*" has been adopted, the best example of which is found in Frankfort-on-the-Main.

Mr. Hering found, compared with American cities in general, that much greater care was given not only to the design and construction, but especially to the maintenance of the sewers. Frequent and thorough inspection was found to be exercised everywhere. A regular system of cleaning was considered as important as the building of the sewers themselves. He walked through hundreds of them and seldom perceived an odor as strong and disagreeable as is frequently noticed on our sidewalks near an inlet. In Paris the "egouts" are frequently visited by strangers, including ladies. In Hamburg, the Crown Prince of Germany took an hour's trip through one of the large sewers. Mr. Hering was generally escorted by the Chief Engineers or the assistants, who think nothing of a walk through their sewers, because, as far as the odor is concerned, there is little or no difference than in going into a common cellar.

The cost of city drainage averages about the same as with us. The expense of a regular inspection cleaning and repairing is little greater than what we pay fer repairs alone. Of course the price of labor is somewhat less, but the municipal engineers, however, are better paid, as a rule, than in the United States. All appointments are permanent, the best fitted are generally selected for office and pensions await any disabled servant of the corps, from the chief down.

There is no small field for improvement in the sewerage of our own city, and the experience gained by so many other large cities could be very profitably put to use for our own benefit, not to save money, but to get more efficient works for the amount we are spending.

Finally, Mr. Hering gave a brief description of the methods for purifying the sewage before it is discharged into the rivers.

Dr. H. M. Chance presented a discussion of Prof. L. M. Haupt's recent paper on "Inter-communications in Cities."

HOWARD MURPHY, Secretary.

LIVERPOOL ENGINEERING SOCIETY.—The usual fornightly meeting of the Society took place in the Royal Institution, Colquitt street, on Wednesday evening, Mr. Alfred Holt in the chair. A paper, by Mr. F. B. Salmon, was read on "Lamination and Defective Welds in Iron." The paper was a very interesting one, and when published will prove a valuable addition to the literature on the above important subjects. A cordial vote of thanks was awarded to the author.

LIVERPOOL, April 28, 1881.

THE SURVEYOR IN PERSPECTIVE.*

BY H. D. BARTHOLOMEW, CITY ENGINEER, LANSING.

Mr. President and Gentlemen of the Association:

At the request of your Secretary I have spent what little time I could command in looking up the status of the profession, in the various States of the Union, and the proceedings of the several surveyors' and engineers' conventions held during late years, as a preparatory study in determining what legislation we should ask for in Michigan.

Out of the thirty-eight States in the Union, in ten the surveyor is not a public officer; to wit: the six New England States, with Delaware, New York, New Jersey and Illinois, which abolished the office of county surveyor at the last election.

In eleven States he is a constitutional officer, viz.: Arkansas, Colorado, Indiana, Kentucky, Maryland, Mississippi, North Carolina, Oregon, Pennsylvania, Virginia and West Virginia.

In sixteen States he is a legal officer, a creature of the Legislature, as follows: Alabama, California, Florida, Georgia, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Nevada, Ohio, South Carolina, Tennessee, Texas and Wisconsin.

In one his status is doubtful—Michigan.

In three States the certificates of the county surveyors only are prima facie evidence of the facts stated, in surveying and subdividing land, and laying out towns and additions, to wit: Arkansas, California and Florida.

In five States the county surveyor has charge of the unoccupied State lands lying in his county, viz.: Georgia, Louisiana, Maryland, North Carolina and South Carolina. In thirteen States no person is named for surveying and subdividing land and laying out towns and additions, and it would seem that it is free to all, being the five States in which the county surveyors have charge of the State lands, with Alabama, Kansas, Kentucky, Mississippi, Nevada, Pennsylvania, Tennessee and Texas.

In the other twenty-two States the business is free to all competent surveyors.

To return to the doubtful State, our Michigan, the following are the facts as I find them:

Under the constitution of 1835, he was a constitutional officer. See section 4 of article 7 of that instrument.

The first State law on the subject is found in the Revised Statutes of 1838, sections 62 to 70 of chapter 3, title 3, which is practically the territorial law of April 23, 1833.

Michigan was set apart as a territory January 22, 1805. In 1806 we find the first law concerning a surveyor, passed September 14—a single section. His duties were increased by the act of May 18, 1807, in which he is directed to mark the places for shade trees in Detroit by driving stakes.

On June 8, 1819, we find a fuller, more complete law, entitled "An act to provide for the appointment, to define the duties, and to fix the compensation, of the surveyor of Michigan and his depu-

*Read before the Michigan Association of Surveyors and Civil Engineers at meeting held at Lansing in January, 1881.

ties." This act provides for a surveyor with any number of deputies, and repeals the former act. This act was amended March 2, 1821, in several points. By one provision at least one deputy was to be appointed in each county. July 31, 1830, the law was revised. The surveyor for Michigan was done away with and a district surveyor appointed by the governor in each county. On April 23, 1833, the law was again revised, the governor appointing with the advice of the council, and the term of the surveyor's office was for four years.

The revised statutes of 1838 were amended by act 54 of the laws of 1845, declaring that the records belonged to the office.

The laws were again revised in 1846. See sections 95 to 106 of chapter 14, title 3, where the old territorial title is changed to county surveyor in every section, except 97 and 105, where the word county is omitted.

In 1850 a new constitution was adopted. In the debates of the convention that framed that instrument the words county surveyor appear only twice. First on page 315 of debates, July 9, 1850, in the committee county surveyor is reported with other county officers. Second, on page 518 of the debates, July 22, 1850, in the convention, the section came up for passage. Mr. Daniels, of Lenawee, moved that county surveyor be stricken out, as the office was unnecessary, and often quite inconvenient for the people, citing New York state. The motion was carried, the section as amended passed. See section 3, article 10, of present constitution. For provisions to adapt the laws relating to county surveyors to the new constitution, see schedule, sections 1, 8, 13 and 14.

Section 2 of act 172, of laws of 1851, amends section 15 of chapter 15, title 3, of the revised statutes of 1846, stating who can fill a vacancy in the office of county surveyor, now found in section 15 of chapter 11, compiled laws. No other act of the legislature from 1846 to 1861 contains the words county surveyor.

In 1857 the laws were compiled under section 15 of article 18 of the constitution, when sections 95 to 106 of chapter 14, title 3, of the revised statutes of 1846, were copied verbatim into sections 95 to 106 of chapter 10, compiled laws.

The legislature of 1861, by act 260, amended sections 100 and 106 of chapter 10, compiled laws, requiring the county surveyor to make a fuller record and modifying his fees.

In 1865 the legislature, by act 223, amended section 103 of chapter 10, compiled laws, giving the county surveyor fuller instructions as to corners.

Again, in 1867, by act 108, they amended section 106 of chapter 10, compiled laws, increasing the county surveyor's per diem.

In 1869, by act 140, they repealed act 260 of 1861, and act 108 of 1867, and re-amended sections 100, 102, 103, 105 and 106 of chapter 10, compiled laws, leaving the law as we have it in sections 95 to 106 of chapter 10, compiled laws of 1871, for since that date the legislature has not mentioned the county surveyor.

You will notice that the legislature of 1869 did not repeal act 223 of 1865, but re-amended the same section, and the compiler, on the principle that the last amendment is binding, did not copy any of the law of 1865.

In section 6 of chapter 1 is the only other place where county surveyor appears in the compiled laws, where he is declared in common with other county officers entitled to a copy of the laws, which was also copied from the revised statutes of 1846, section 6 of chapter 1, title 1.

Referring to the compilation of 1871, we find county surveyor mentioned ino nly three distinct places: In section 6 of chapter 1, granting him a copy of the laws; in sections 95 to 106 of chapter 10, defining his duties, privileges and compensation, and in section 15 of chapter 11, stating who can fill a vacancy in the office.

For our purpose we need only examine sections 95 to 106 of chapter 10.

Sections 95 and 96 are technical. Section 97 provides that the certificate of the surveyor or his deputy, of any survey made by him of any lands in the county shall be presumptive evidence of the facts therein contained. In the original law of 1838, it was competent and presumptive evidence. In the territorial law it was legal evidence. You will notice that the word county is not prefixed to surveyor, this having been copied from the territorial law as before remarked. But the real question on this section is, does it give any exclusive privileges to the county surveyor? Is not the certificate of any well-known surveyor presumptive evidence of the facts set forth therein concerning his surveys?

Section 98 provides that the county surveyor shall make such surveys as may be required of him by order of any court, that is, any survey the parties interested do not, or cannot, find any other surveyor to make under sections 11, 12 and 13, of chapter 200, compiled laws, or by application of any person therefor, who does not choose to employ any other surveyor.

Section 99 is technical. Section 100 gives the county surveyor an advantage over his brethren in regard to the county records.

Section 101 is technical. Section 102 supplies him at the expense of the county with certified copies of the field notes and plats of the original surveys by the United States.

Section 103 tells him how he must survey; other surveyors can do as they think best.

Section 104 is technical. Section 105 gives him the preference in a neighborhood quarrel.

Section 106 prescribes his fees, which are not exorbitant.

In the following cases the officials having charge of the work are left free to employ any surveyor they may choose: Highway commissioners, sec. 8 of chap. 10; commissioners of partition, sec. 26 of chap. 193; commissioners on light-house sites, sec. 2 of chap. 222, compiled laws of 1871; commissioners on State roads, act 154, laws of 1869, on page 449, compiled laws; boards of supervisors in marking section corners, acts 159 of 1877 and 205 of 1879; the commissioner of the State land office in restoring lost corners and marking unsurveyed ones, act 11, laws of 1879. Perhaps some of you may think I was mistaken in calling Michigan doubtful. I may have been.

Of surveyors' conventions, I have noted the following: The two held in this State in 1868 and 1869, under the old organization, the first of which did not discuss the office of county surveyor, or the subject of examination and license; but the second, the one held at Grand Rapids, took a decided stand against our present system of county surveyors and in favor of a State board of examiners, who should grant licenses or diplomas to competent surveyors, Mr. Tinkham saying that some eminent lawyers had given the opinion that no such office as county surveyor had ever been legally established.

The next convention bearing on the subject, of which I have any notes, was held Jan. 7, 1879, by the Civil Engineers' Club of the Northwest, at which Mr. James M. Bourne, of Springfield, Ill., read the draft of a law for the examination and appointment of licensed surveyors. As most of you have doubtless received a copy of the same from Mr. Bourne, I will not notice it further than to say that it was followed by a thorough discussion, in which county surveyors were handled without gloves.

The next association in order was that of the county surveyors of Ohio, Jan. 15, 16 and 17, 1880. They did not call for the abolition of the office, but would restrict it to those who have passed an examination and possess the qualifications necessary to civil engineering. They were in favor of a State board of examiners, calling for better and more accurate instruments, surveyors educated to a higher standard, and fuller and more complete plats, maps and records.

I need but mention our first annual meeting held March 24, 25 and 26, 1880.

On October 20, 1880, the surveyors of Kansas held a convention at Junction City, but after repeated efforts I have been unable to open any communication with Mr. Hibben of Emporia, Lyon Co., the secretary, and do not know the range of their discussion.

On October 27, 1880, the engineers and surveyors of Pennsylvania met in convention at Harrisburg. Although they did not discuss county surveyors, it was conceded that they had better ones under the old system of appointment by the surveyor general, than they could get by election. They called for better instruments, to be kept up to a high standard by periodic tests, especially chains and needles; also for a stricter enforcement of the law establishing the true meridian and a standard United States measure in each county. The draft of a law for a State board of examiners, covering also the above points, was submitted, freely discussed and amended, after which a committee was appointed to submit it to the legislature.

On Oct. 6, 1880, a congress of surveyors-general convened at Salt Lake City, Utah. The main point of interest to us in that congress is contained in the closing words of commissioner Williamson: "It will tend to a more uniform system of administering their duties, and lead to improvements in methods."

The cry is heard, from the lowest to the highest, all along the line, "Surveyors, advance."

From this study I have come to this conclusion: Give us as little law as possible on surveying, but a simple, comprehensive, yet strict law, looking toward better and more accurate instruments, surveyors of larger and better training, fuller and more complete records.

CIVIL ENGINEERS.

The annual demonstration which is made by the Institution of Civil Engineers, in the form of a dinner at Willis' Rooms, has perhaps always excited, on account of its remarkable success, a little excusable envy among some other professions. The reason is that the occasion is so entirely practical; it is the festival of applied science, in England as the home of applied science, and in an age which is the age of applied science. As if to accentuate still more the condition of things which it represents, some geographers have of late begun to impress upon us the circumstance that England stands in the very center of the habitable superficies of the globe. Take the whole complex area of dry land just as it lies, and England, they say, occupies the central point of the whole. Whether this is indicative of something like permanency being attained at last in respect of practical dominion—the dominion of industry and commerce—we can scarcely say; but to many minds such an idea may appear at least as feasible a supposition as the other, so well known and so often quoted, that the influence of empire, pursuing its way westward and still westward, and already laying hold of the wilds of America, will, after a time, forsake Europe altogether as it has long ago forsaken Asia, and in turn leave even America itself behind, as it stretches away over the wide Pacific to begin a new career in Japan. But be all this as it may, thus much at least is certain, that, for the present, England is the heart of the industrial world, and the engineers' dinner a notable manifestation of that fact.

It is no idle display, therefore, or empty courtesy, when this banquet is honored, as it always is, by the presence of one or more of the members of the Royal House, and a sufficient representation of the Ministry, the Legislature, and the diplomatic body. If the Church, the Law, the Arts, and Literature are generally left more or less out of account, this only exhibits all the more the thoroughly practical character of the occasion—we had almost said its exclusively useful character. The engineer is nowadays not only a "power" in the world, but one of the principal powers; and it is this that princes, prime ministers, lords and commons, ambassadors, and all other magnates—even bishops and chief justices if they were to be called upon—must perforce recognize and approve in spite of any quantity of old and obsolete considerations, until none but Mr. Ruskin alone dare say a word to the contrary, if even he.

Lord Kimberley's quaint illustration of the results of engineering progress, in the frightening of His Majesty of Ashanti by the laying down of an electric telegraph, was not a mere jest. At this moment, when the powers of what we may call darkness without intentional disrespect, with their multifarious fetishes and bugaboos, are being slowly but steadily undermined throughout the whole world, there can be no doubt that the engineer is doing more than any other missionary of civilization to bring about the impending change. There are several overpowering advantages which he possesses; he does not talk, he acts; he does not kill, he creates; he does not curse (except in another sense), he blesses. Well might King Cuffy take more serious counsel with himself in respect of threatening war, when the terrible white demigods began to stretch over his harmless wildernesses their mysterious wire, by whose soft unseen lightning, not only does an American Minister whisper across the Atlantic as if it were a brook, but has the message which he sends off this morning delivered yesterday afternoon. "He thought little," says Lord Kimberly (not quite *little*, it is to be hoped), "of our soldiers or of our ships, but when he heard that a telegraph was to be laid down his mind became filled with terror." The electric telegraph, in fact, is but a symbol of the effect of the whole scheme of the engineer's procedure throughout the earth's surface at large. Taking England, indeed London, as the focus, he is throwing out in every direction, and to more and more remote extremities every day, his railway lines, his navigation lines, his postal lines, his telegraph lines, to convey to the uttermost distances, with the utmost rapidity, the universal interchanges of commerce and the continual communications of friendly intercourse. Well may a secretary of

state for the Colonial Empire of England say that the guild of our engineers has become a political power—"one of the political powers of the world," —and that "the work of the civil engineer has probably produced a greater political effect than all the wars of the present century." Even if Lord Kimberley were less of the prosaic man of business than he is, there is not in this language the slightest trace of hyperbole. It is the language of simple soberness; such as a lecturer at the very Institution of Civil Engineers itself might dispassionately use before an assembly of his brethren, to impress upon them the plain and palpable importance of the work committed to them to do. They are, in the strictest sense of the words, a great political power; why not the very greatest of the day? The aggregate effect of their operations throughout the globe is the greatest of all aggregate effects; even the elements, with their storms and frosts, avalanches, conflagrations, volcanoes, do less of general mischief than these mortal men accomplish of general good; the very gods of war in their fury occasion but local disturbance, while in their calm diligence the laborers of science are creating universal prosperity and peace. There is in the mere Philistinism of this a new poetry of nature, the poetry of the real instead of the unreal, of living nerves and muscles instead of shadows and dead bones. Few considerations are more impressive to the mind of a reading and thinking man of the present day than those which turn upon the insignificance of the human race as a corporeal or material aggregate sprinkled over the face of the planet. Even in the most populous countries the traveler is struck with the thinness of the population. So also with the evidences of civilization; except it be in the division of the fields by unseen hands, he can scarcely discern what civilization is. Neither does the mental condition of mankind suggest to him more satisfying thoughts; the vast mass of humanity is but little elevated above the brutes, and the prospects of advancement, if the truth may be told, are of the poorest. If the world is destined to become well peopled, or well cultivated, or well instructed, or all together—as it probably is—the length of time this is to take we leave to the computation of the reader; but to the question how it is to be accomplished we do not hesitate to return the immediate answer—*by the Engineer*; and if we even go so far as to add that the typical engineer is an Englishman, we do not suppose it will be taken as an idle boast. "No one," Lord Kimberley, in his thoughtful if post-prandial way, goes on to say, "can anticipate the effect of the constant communication of one country with another. It is beyond the power of man to forecast the influence which this swift intercommunication of feeling and sentiment may exercise in the course of time." And thus, "I am addressing a body of men," he aptly concludes, "who are in reality among the greatest social and political forces the world has ever seen." Following this, Lord Derby, who, as a practical man, had the wind taken very much out of his sails by such substantial and realistic discourse, had to confine his remarks to a different topic; but Lord John Manners and the American ambassador, as poetical persons, had a message to deliver of another order, but not of less force or majesty of truth. To the one of these the task of the engineer is still clearly developed in the wonderful variety of his work in coercing the rude powers of nature. Adopting the terse description of Pope, here the harbor of safety is planted; there the long road of commerce is laid down; the strong arch spans the flood; the sullen mole shoulders off the anger of the waves; the embankment confines to allotted limits the very bulk of ocean; and the rush of resistless rivers is made obedient to the touch of man. To the other speaker the doer of all this is "maker and master of the modern world," above all men *Pontifex Maximus*, annihilator of the obstacles of space and time, the magician who at length has realized the old-world dream—Earth, a sentient thing! These are not after-dinner platitudes; a body of men to whom orators with a reputation to lose would dare to address such compliments is not to be found elsewhere; an Œcumenical council would consider itself outraged by such flatteries; even an assembly of German professors would treat them with derision, and a half-drunk military mess pronounce itself palpably insulted.

It is the particular charm and virtue of a thoroughly efficient engineer that he has none of that personal conceit which, with other wise men of various kinds, is so frequently essential to idiosyncrasy. This is due, no doubt, to the extremely practical nature of his thoughts, the massive bulk of his work, and the weighty realities of his responsibility. He does not fiddle-faddle with details, split halfpence, laugh over his work, or chuckle over it. He does not, dare not, in any sense trifle with it, or make it pretty, or picturesque, or grotesque, or even statuesque. He must not touch it tenderly, or timidly, or tentatively, or in any other way with femininity, or feebleness, or fallacy, or falsity; or the devil, as he will tell you, would very soon fly away with it and him together. Outraged Nature, in another view of the case, is lying in wait for him at every turning, to turn him upside down if she can. The laws of matter, which he presumes to bring so closely to account, will give him a sly trip, he may be well assured, on the first opportunity, and on every opportunity; and if he should haply fall down and break his crown, it will be to the tune of "Physician, heal thyself." It is no wonder, therefore, that he should wear a grave and serious countenance, and speak well-considered and weighty words. Even the light reading of the Institution in Great George street is heavy; and so it should be.

Comparisons are odious; but the architect, for example, is manifestly a very different sort of functionary from this muscular operator. Not only so, but in the future of our modern world the two are likely to diverge more and more both in their functions and in their character. They never were really associated in one person, as is commonly said with reference to such men as Michael Angelo and Leonardo, who were in fact neither the one nor the other. But one thing at least that may be cultivated and encouraged is a feeling of mutual respect and understanding, and indeed admiration, without which neither engineer nor architect can be said completely to appreciate the noble position that he occupies.—*The Architect.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Bids for building the Salem, N. J., water-works will be received up to May 18.

The New York Legislature has passed a bill relative to the formation of town water-works companies.

The N. Y. State Senate on the 10th passed the bill to incorporate the St. Johnsville Water-works Company.

The New York Legislature, on the 10th, passed the bill incorporating the Clifton Springs Water-works Company.

The Reading Iron Co. has delivered 900 tons of the 10,500 tons of piping contracted for the West Chester, Pa., water-works.

The boring of the Artesian well near the Providence station at Boston has been discontinued after going down 2,100 feet, the well yielding 16,000 gallons of water each 24 hours.

Wakefield, Mass., decided Monday, by a vote of 282 to 252, to guarantee the payment of interest at 6 per cent. on $50,000 of bonds, issued to construct its water-works. The bonds are to run twenty years.

The Holley Manufacturing Company, of Lockport, has closed the contract for a quadruplex compound condensing engine, with boilers complete, for direct pumping for the Milford (Mass.) water-works.

A company has been organized in Peoria, Ill., under the title of the Peoria Water-Supply Company, the object of which is to supply the city with pure water from springs on the opposite side of the river.

The Water Committee of Allegheny Councils met on the evening of the 9th and took action in the matter of water supply for the hill districts. The City Engineer was instructed to draw up the plans and the Controller to advertise for bids. The estimated expense is $16,094.24.

MADISON, Wis., May 6.—A well-attended meeting of prominent citizens was held here last evening to take into consideration the establishment of water-works in the city. To-day the committee appointed to decide on the matter reported in its favor, and the works will be established during the coming summer.

In the item under "Gas and Water," Page 188, *ante*, about proposals for water-works at Norwich, N. Y., the Warren Foundry and Machine Company are credited with a bid, which, we are informed by the company, is incorrect, as they never bid for the building of water-works, their business being the manufacture of cast-iron water and gas pipe.

The town of Portage la Prairie, Manitoba, the second town in importance in the province, advertises to sell bonds to the amount of $40,000, to June 15th, the money to be applied for permanent improvements in the town of Portage la Prairie, for the purchasing of steam fire engine and necessary appliances, and also for the building of a market house, etc. W. A. Prest is the party to address.

Mr. Ross Mitchell, having accepted the terms offered him by the Springfield, O., water-works trustees, they have decided to locate their pumping machinery and reservoir on his ground in the eastern part of the city, as at first intended. The price paid was $16,000 for sixty acres. Mr. H. M. Clough, of Middletown, O., has been awarded the digging contract for pipe-laying purposes; the Newport, Ky., firm not furnishing sufficient bond.

The catastrophe at the Nice theatre, owing to a defective gas pipe, has called attention to the necessity of providing against such accidents. A very ingenious gas alarm apparatus is described in the Vienna *Technological Gazette*. A cap with porous cover, which allows gas to enter more quickly than common air, and then act on a small column of mercury which presses on a platina wire, and this latter, which acts on a battery, form the chief features of the invention. The instrument can be erected in private rooms, and would seem to fulfill the purpose.

Controller Gurney, of Chicago, had a talk with City Engineer Cregier in reference to a better supply of water for the city of Chicago. The amount of money required to extend the system and give pure water the year round will be about $5,000,000. The plan is to build two tunnels, of eight feet each, from Grosse Point, which is twelve miles north of the city limits. Here the water is deep and clear. The tunneling is to be done on the shore, and commenced from both ends, shafts to be sunk one mile apart. The water a half mile out from the shore is thirty-three feet deep, quite as deep as it is opposite Chicago, three miles from shore. The plan, though not fully elaborated, is to connect with the West Side tunnel and North Side wells. No new pumping-works will be required under this plan, but merely an enlargement of the tunnel opening. The work would cost about $50 per foot, or about $4,250,000 for tunneling alone. The income from water rents now amounts to about $1,000,000 or more annually, of which about 50 per cent. is clear profit. If a loan of $5,000,000 were contracted by law, the bonds could very easily be floated at four per cent., and the additional revenue would pay the interest, which would amount to but $200,000 per annum. In a few days the city engineer will go up north to look over and examine the ground.

Judge Blodgett, of the United States Circuit Court, on the 5th decided the case of the consolidated Safety-Valve Company, of Boston, against E. B. Kunkle, of Fort Wayne, Ind. This was a bill filed in October last by the complainants to enjoin the defendant from manufacturing what is known as the Richardson safety-valve for steam engines. The Court held that the valve made by Kunkle depended for its operation to some extent, if not wholly, upon the principles used in the Richardson valve. The Court said that in administering the patent law, the most dangerous pirating upon well-established patents were those that simply approximated to the results by falling a little short in some of the elemental parts and yet come near enough to produce the result the patentee intended. In conclusion, the Court held that the Kunkle valve was an infringement of the valve owned by the Consolidated Safety-Valve Company, and gave Kunkle the privilege of giving a bond to answer whatever damages might be adjudged on final hearing of the case, or in default of such bond a preliminary injunction should issue restraining the further infringement of the Richardson patent. Col. Thomas William Clarke, of Boston, Mass., and R. L. Tatham, of Chicago, appeared for the complainants, and J. H. Raymond, of Chicago, for the defense.

City Engineer Cregier, of Chicago, has completed his fifth annual report of the workings of his department for the year 1880—a very elaborate and interesting document, and a model of patient research and analytical skill. The report states that the net quantity of water delivered to the city during the year was 21,000,000,000 gallons, a gain of 2 per cent. over 1879, the daily average being 57,000,000 gallons, or 1,000,000 gallons more than the previous year. The following is the cost of delivering water per million gallons during the past ten years, and cost of coal:

	Average cost of coal per ton.	Cost per million gallons.
1872	$8.09	$12.02
1873	7.18	11.64
1874	8.56	12.86
1874-5	8.27	12.26
1875 (9 months only)	7.93	10.81
1876	7.15	9.56
1877	5.38	7.09
1878 (estimated, screenings used)	4.39	6.24
1879	4.14	5.65
1880	4.83	5.68
	$6.50	$9.38

Owing to the near extension of the water pipes in the section of the city nearest the West Side works, a corresponding increase is expected in the demand for water in that locality, and as the head of water is gradually decreasing at the West Side works, Mr. Cregier presses again the importance of completing the West Side pumping-works by the erection of two additional pumping-works. Mr. Cregier makes an estimate of the water supply, capacity of pumping-works, cost, etc., that will be required for the next five years, basing his figures on the record of the past twenty-one years. According to these figures, in 1882, the actual supply required will be 63,930,774 gallons per day, or 106.4 gallons to each inhabitant; average quantity per mile of pipe, 128,910 gallons; capacity of works per mile of pipe, 209,677 gallons; capacity of works, 104,000,000 gallons per day; $1,039,131 revenue; population of the city, 600,450. He estimates that the actual supply required will increase from 57,000,000 gallons per day in 1880 to

69,000,000 gallons per day in 1884, for a population of 704,000, while the pumping works need not have their capacity extended beyond 104,000,000 the present capacity. The following table shows the cost of works for water supply in various cities, the cost per capita, etc.:

Cities.	Cost of water-works.	Population.	Cost per capital.
Detroit	$2,750,700	119,000	$23.11
Newark	2,671,580	140,000	19.08
Wilmington	912,120	44,000	20.73
Albany	.....	85,000	.....
Buffalo	3,000,000	164,000	18.29
Cincinnati	6,813,000	260,000	26.20
Milwaukee	2,227,482	115,702	19.25
Columbus	943,513	52,090	18.14
Louisville	3,906,141	156,000	25.04
Cleveland	2,628,319	156,000	16.84
Providence	5,530,347	104,850	52.74
Boston	18,320,000	412,000	44.46
Manchester	800,000	33,000	24.24
Hartford	1,495,519	42,000	35.60
New York	35,820,081	1,041,886	34.28
Philadelphia	18,703,519	817,500	23.00
St. Louis	.....	400,000	.....
Brooklyn	.....	485,000	.....
Chicago	8,802,825	503,304	17.49

It will be seen by the above figures that the cost of water per capita is smaller in Chicago than in any other of the nineteen cities mentioned, except one, Cleveland, the cost of whose water is about one-quarter that of Chicago. The long-continued severe weather of the present winter has exacted extra vigilance to guard the hydrants from the effects of frost. The pipe district has been divided into sections, and a party of men, properly equipped with suitable facilities for keeping the hydrants free from frost is assigned to each section. The hydrants have thus been protected and kept in working order. Most of the hydrants in the business portion of the city are protected with sawdust. So long as this material is kept dry, it answers the purpose fairly, but it is difficult to maintain it in this condition. In most cases the sawdust is wet, and in cold weather freezes, and becomes useless for the purpose intended. A large number of hydrants have been repacked during the winter, and it is believed they have in all cases been found ready for use when wanted, as little trouble or complaint have been reported in this regard by the Fire Department. Mr. Cregier recommends that public fire hydrants should not be used without a permit designating the particular hydrant or hydrants to be used.

STREETS, DRAINAGE, ETC.

The New York State Board of Health held its annual meeting on the 10th inst., and re-elected last year's officers. The committees of last year also remain without change, save that Erastus Brooks is added to that on Drainage, Sewage and Topography.

The new Board of Sewer Commissioners for Wooster, O., are Jacob Palmer, President, J. S. Caskey, Vice-President, Jno. F. Barrett, Adam Foss, and H. H. Bissel. This board contemplates some extensive improvements in the sewerage of the city during the coming summer.

AKRON, May 6.—Hosea Paul, civil engineer of Cuyahoga Falls, formerly of this city, has begun a survey to relocate the old Clinton air line railroad from Hudson west as far as the Cuyahoga River, under the direction of D. C. Coalman, master of the roadbed of that line. It was constructed years ago when the route was first laid out, but the enterprise fell through and it was abandoned. Now it is being revived with good prospects that something will be made out of the marks which have been useless for many years.

The Council Committee of Akron, O., consisting of President J. P. Alexander, D. L. King, M. Housel, Councilmen, and Solicitor Cabbs have agreed to recommend to the City Council the following improvements: East Market street, paving, $74,000; Mill street, paving and extension, $20,000 and Main street conduit and grading, $18,000, making a total of $112,000 to be expended on these improvements during the coming season. The city will be recommended to pay one-fourth of this expense out of funds at the disposal of the Council.

The Neuchatel Asphalte Company, office 54 Astor House, has lately laid a large area of floors with its asphalte in the sugar refinery of Messrs. Havemeyer & Elders, Williamsburgh; floors in the Harmony mills, Cohoes; in the mills of the Merrimack Manufacturing Corporation, Lowell, Mass.; Messrs. Bolton's brewery, Lansingburgh, N. Y.; the stables and floors of the Albany Brewing Company, Albany; stables for Mr. Lindsley, architect, Newark, N. J.; for the American Horse Exchange, Broadway and Fiftieth street; for Mr. Adrian Iselin, New Rochelle, and is now laying walks in St. Paul's Churchyard and at St. Augustine's, Houston street, for Trinity Church Corporation. The company has appointed the American Asphalt Pavement Company of New England, 31 Milk street, Boston, its agents for Massachusetts, and has contracts in Boston to lay floors in the Standard Sugar Refinery, for Messrs. Snell & Gregerson, architects, and other parties.

BRIDGES.

A stone bridge over Chambers Creek, in Newburgh City, N. Y., and town of New Windsor, Orange County, is to be built.

The bill for the bridge at Cornwall-on-the-Hudson has been ordered to a third reading in the New York State Legislature.

Work on the new bridge was commenced at Elgin, Ill., May 4. The bridge will be of the same dimensions as the one recently swept away.

The Henderson Bridge Company, a corporation created under a statute of the State of Kentucky, intends to construct a bridge across the Ohio River at Henderson, Ky.

The Cincinnati, Wabash & Michigan Railway put in its new Howe truss bridge over the Mississenawa River at Marion, Ind., on the 10th. There was no delay to trains. The bridge is considered the heaviest Howe truss wooden bridge ever put up.

PROJECTED PUBLIC WORKS IN ITALY.—The Council of State has approved the plans for a construction of a portion of the Ascoli & San Benedetto line; length, 10 kilometers; greatest gradient, 8.25 in 1,000; estimate (including the construction of six bridges), 540,000 lire, of which 425,500 lire will be open to tender.

LOUISVILLE, Ky., May 5.—By a vote of 8 to 4 to-night the members of the Eastern District of the Louisville Council agreed to submit to their constituents a proposition to vote a $600,000 tax to the Boone Bridge Company. This company has a charter to erect a bridge for railway, street-car and pedestrian purposes across the Ohio at this point. The proposition, if carried, grants exclusive right of way for ninety-nine years. There is now one bridge over the Ohio here. The City of Jeffersonville, Ind., has voted $250,000 to the Boone Bridge Company.

RAILROADS.

The Eads Ship Railway has been unanimously approved by the Mexican Chamber of Deputies.

The Georgia Iron Works, of Atlanta, formerly the Atlanta Rolling Mill, has suspended payment.

The cable system of street railroads will be introduced in Cincinnati if the City Council will give permission.

The Senate of Mexico has passed a bill authorizing the President to make contracts during the recess of Congress for constructing railroads.

A company has been organized to build a railroad from Mobile, Ala., to deep water at Cedar Point, on the Gulf of Mexico, some twenty miles.

Grading commenced on the Continental Railroad at Ft. Wayne last week. Surveyors on the line of this road are working toward Spencer, Ind.

The South Division Street Railway Company, of Chicago, will begin next week to lay a cable on State street to run their cars on the San Francisco plan.

The test of the grade of 120 feet to the mile on the Cincinnati Northern Narrow-Gauge Railroad was made on the 6th, and considered against the grade as unsafe.

The Lake Shore & Michigan Southern Railroad Company pays a premium of $15 per month to the engineer showing the greatest economy of fuel, and $10 to the engineer making the second best showing.

Gen. W. H. Gibson and his surveyors, who are locating the line of the New York, Chicago & St. Louis Railroad, are objects of great interest to the residents of numerous towns in Ohio near which that line is being located.

The Toledo, Belleville & Detroit R. R. was incorporated last week, and the following board of directors elected: Solon Humphreys, J. M. Osborn, A. W. Cotton, J. H. Fancher, Robert Andrews, J. R. Osborn, F. B. Swayne, and K. H. Wade.

A sleeper is one who sleeps; a sleeper is also a place where a sleeper can sleep, and a sleeper is, too, a thing over which runs the sleeper in which the sleeper sleeps; so that the sleeper in the sleeper sleeps while the sleeper runs on, as well as sometimes leaps off the track.—*Wit and Wisdom.*

THE RAILROAD FEVER IN JAPAN.—YOKAHAMA, April 21, via San Francisco, May 8.—A scheme has been projected for building nearly one thousand miles of railway, running to the western end of the northern limits of the main island, and a native company is forming for the purpose of carrying it out.

The Rocky Mountain railway surveyors, in charge of Mr. P. K. Hindman, Civil Engineer, numbering thirty-six persons, left Winnipeg on the 6th, via Bismarck and Missouri River, for Fort Benton, where they will procure their outfit before going up again on Canadian territory on the east side of the Rocky Mountains.

The sums asked for the Hoosac Tunnel appropriation are as follows: For the extension of side tracks, $12,000; telegraph construction, $2,000; stone ballast in the tunnel, $2,000; 50 feet of arching in the little tunnel, $8,500; four iron-plate girder bridges, $4,000; fencing, $500; one locomotive, $6,000; one steam snovel, $7,500; extension of the yard and sidings at North Adams, $72,000; dump cars, $10,000; double tracking any portion of the Troy & Greenfield railroad east of the eastern portal of the tunnel, $200,000—total, $325,000.

NARROW-GAUGE PROFITS.—Some of the narrow-gauge lines seem to pay well. The dividends from those in the oil regions are especially gratifying to the stockholders. None of these roads have any bonded indebtedness, and last year they paid dividends as follows: The Olean, Bradford & Warren on a capital stock of $150,000, thirteen dividends, twelve at 2 per cent. and one at 5 per cent., making a total of $45,000. The company had a surplus on hand at the end of the year of $1,886,778. The Kendall & Eldred Railroad on a capital stock of $150,000 paid twelve dividends at 3 per cent., four at 6 per cent. and one at 10 per cent., making a total of $105,000. Besides these dividends the company built a plank road costing them $1,176,659, which earned $2,700 above expenses in about six months. At the end of the year this company had a surplus on hand of $2,553,150. The Bradford, Bordell & Smethport Road traverses an unbroken wilderness its entire length of twenty-five miles. It commenced doing business in June of last year, but the road was only running a distance of seven miles at that time. In September the company commenced declaring a dividend of 2 per cent., and continued to declare that dividend monthly to the end of the year on a capital stock of $250,000. At the end of the year the company had a surplus on hand of $2,651,089. These facts are gleaned from the sworn reports of the officers of the road to the Secretary of Internal affairs. These statements will soon be published in connection with the general railway report to be published by the department.

NEW PROJECTS.

The Wooster (O.) & Lake Erie R. R. Company was incorporated on the 10th.

Articles incorporating the Bradford, Eldred & Cuba Railroad Company and the Rockaway Beach Transit Company have been filed with the Secretary of State. The capital of the former is $500,000, of the latter $100,000.

The Friendship Railroad Company has been incorporated. The road is to run from Friendship, Allegany, to the State line, in Portville, Cattaraugus County, the distance being about 22 miles. The capital stock is $100,000.

CONTRACTING, MISCELLANEOUS, ETC.

Vermont is expending $22,000 on its State prison.

A new hotel is to be built in Omaha, Neb., by a joint-stock company. The site has been contracted for.

J. P. Lyons, who received the contract for the Parliament buildings in Manitoba, has gone to Winnipeg.

HAMILTON, Ont., May 10.—The bricklayers' and plasterers' laborers have asked for an increase from $1.10 to $1.50 per day.

LONDON, Ont., May 10.—The bricklayers have decided to demand an advance from $2 to $2.50 from and after the 1st of June.

Messrs. A. Knisley & Co. are furnishing the Hayes patent skylights for the city hall of Chicago. The contract amounts to over $10,000.

Manning, McDonald, McLaren & Co., contractors for Section B, Canada Pacific Railroad, are now offering $1.75 per day for laborers on that work.

Sealed proposals for improvements of the Ravenna, O., Court-House will be received by the County Auditor from May 23 to June 2, when the bids will be opened.

Mr. John Stewart, of East Williams, Ont., has taken a contract from the Canadian Pacific Railway syndicate for the building of a twenty-mile section of that road.

Contractors on the thirty-fifth parallel line of railway in Arizona announce that they are ready to give employment to 1,000 or 2,000 men at wages ranging from $2.25 to $4 per day.

Though all movements regarding the proposed Cape Cod ship canal are kept secret, interest is piqued by the purchase by parties connected with the enterprise of land on the site of the projected line.

CITY OF MEXICO, May 11.—General Grant to-day signed the new contract with the Mexican Government, embracing the extensions of the Mexican Southern Railway. It will be submitted to the Congress to-morrow.

PARIS, May 9.—The American machinery which, under the old tariff, paid from 18 to 36 francs duty, will now pay 6 francs, the same as English machinery. A large quantity of it is waiting at Havre to be entered under the new tariff.

The contract for boring the tunnel through Boston Mountain, on the Arkansas Division of the St. Louis & San Francisco Railroad, between Fayetteville and Fort Smith, has been awarded to Messrs. Keegan & Scully. The tunnel is to be 1,550 feet long and to be finished by January 1, 1882.

The contract for building a Catholic church at Mansfield, O., has been awarded. The church is to be of brick, with stone trimmings, Gothic style, and to cost not less than $30,000. The interior is to be finished in walnut. The steeple will be one hundred and fifty feet high. It is expected to seat more than one thousand people.

Nashville, Tenn., is one of the Southern cities now enjoying an industrial boom. During last week the Nashville Cotton Factory was organized with a capital of $100,000, a site purchased on which to erect a factory, and the contract given out for the building and machinery. The factory is to have 4,000 spindles and is to be in full operation by next October. A charter was also granted last week to a company with $250,000 subscribed capital, which has already purchased a site on which will be erected a mammoth foundry, which will be used for the manufacturing of stoves, hollow-ware, iron and brass castings, etc.

PHILADELPHIA LABOR MARKET.—The initiatory action for an advance in wages was made by the bricklayers, who demanded an increase of daily pay to a basis of $2.75, which was granted, since which time other trades have organized for an advance. The carpenters, who have been receiving $2 to $2.25 per day, demanded a settled basis of $2.50 on and after Saturday, April 30, which has been acceded to, except in cases of non-union men, who are now on a strike. The masons, who are now receiving $2.25 to $2.50 per day, intend demanding $3. The plasterers, who get $2 per day, are organizing for 50 cents advance. Other trades are agitated on the same question, some including the question of eight hours as a day's work.